carry water vapour which is condensed by penetrating colder air strata, and are immediately converted into ice-needles. These forms are also found under the more moderate clouds of the lower strata of the atmosphere, but in coarser form. Cirrus clouds gradually change their form in a period which coincides with that of the sun-spots, and consequently are caused by solar radiation. No kind of cirrus-cloud can be used with certainty as a weather sign. The influence of the sun at the time of sun-spot maximum is unmistakable in the case of clouds of moderate elevation.

In the *Journal and Proceedings of the Royal Society of New South Wales* for 1902 (vol. xxxvi. p. 42) Mr. H. I. Jensen contributed a paper on the possible relation between sun-spot minima and volcanic eruptions. This paper contained the results of an examination of the statistics, from 1780, relating to seismic disturbances and volcanic eruptions, and the conclusion at which the author arrived was that the frequency of both these phenomena varied inversely with the sun-spot curve, or, in other words, the fewer the sun-spots the greater the number of earthquakes and volcanic eruptions. In the volume of the same journal for the year 1904 (vol. xxxviii. p. 40) the author pursues the inquiry further, and, as he says, "I have succeeded in collecting numerous facts which throw further light on the question and strengthen my former conclusions." Later on in the paper the author refers to the letter published in the *Times* (May 19, 1902) by Sir Norman Lockyer, who stated that earthquakes and eruptions were most frequent at sun-spot minima and maxima. In this connection the author writes:—"My view was, and is, that these phenomena are at a maximum when sun-spots are at a minimum, although from my later researches it seems that at sun-spot maxima there sometimes is a violent and spasmodic outburst of volcanic violence."

Part ii. of this second communication deals with the connection between sun-spot and meteorological phenomena. The author here collects and summarises the conclusions of many workers, and adds a list of recent papers dealing with sun-spots, prominences, corona, earth-magnetism, auroræ, and meteorological data discussed in relation to solar changes. The communication concludes with a table of seismic and volcanic disturbances which occurred between April 1, 1902, and December 31, 1903.

In March last Dr. W. N. Shaw read a valuable paper before the Royal Statistical Society entitled "Seasons in the British Isles from 1878," which appeared in vol. lxviii., part ii., of the journal of that society. We have now received a reprint of that paper, and as it contains no less than 97 pages, including a discussion which occupies 6 pages, the reader may conclude that the subject has received very minute consideration. As director of the Meteorological Office, Dr. Shaw has at his command the most complete and homogeneous series of meteorological observations of these islands that exists, and in the present compilation he has so arranged the data that they are in a form at once suitable to anyone who may wish to study the relations of various phenomena with British weather. Like most other regions of the world, the British Isles are subject to wet years, dry years, cold years, and warm years, so that successive seasons differ very considerably from one another. Some of the meteorological statistics are therefore arranged to show at a glance the various characteristics of any year or season of the year. The contents of the reprint before us are not, however, restricted to the statistics of the meteorological data alone. We find that statistics relating to fog days in London, gales on the east coast, sea casualties, storm warnings, first flowering of forest trees, shrubs, herbs, beginning of corn harvest, yield of crops, deaths from various diseases, &c., are carefully correlated with the meteorological data according to each of the four seasons of the year. In the course of this compilation it was found that the relation between the autumn rainfall and the yield of wheat was very close. In fact, dealing with data from the year 1885, the yield was found to be above the average when the previous autumn rainfall was below the average, and *vice versâ* (1889 and 1903 excepted). Space does not permit us to deal with this important contribution at greater length, so we must refer those of our readers who are particularly interested in such statistics to the reprint itself.

In a pamphlet entitled "Ueber die wahrscheinlichkeit von periodischen und unperiodischen Schwankungen in dem atlantischen Strome und ihren Beziehungen zu meteorologischen und biologischen Phaenomenen," written by Otto Petterson, we have an interesting and valuable discussion on the correlation of hydrographic, biological, and meteorological data. This pamphlet is an extract from "Gesamtbericht, 1902–4," vol. iii., of the report and *procès-verbaux* of the international committee on the exploration of the sea (August, 1905), with the addition of an interesting introduction in which is briefly and clearly summed up the general hydrographic condition of those particular parts of the ocean referred to in the paper. In dealing with the annual variations it is first pointed out that there exists a temperature change of deep water (250 metres) at Motowskijfjord which reaches a maximum value in about November; this change is brought about by the Atlantic water. Reference is next made to the annual variations of the depths of the sea near the coasts of Holland and Sweden, and here the maximum is again in late autumn, namely, from October to December. It is shown that we are here in presence of a new phenomenon, namely, an annual pulsation of the sea, of which the whole ocean, from the tropics to the polar seas, takes part.

Our attention is then directed to the changes which take place from year to year, and it is shown how similar are the variations of the temperature of the sea on the Norwegian coast and the air temperature in the centre of Sweden. It is pointed out that the annual variation sometimes suffers perturbations, and is at times retarded or accelerated by a month or two; this is accompanied by important climatic and biological changes. The general impression gained is that the maxima and minima of water and air temperatures in the winter months are repeated in alternate years which indicate a two-year period in the hydrographic perturbations. The author then connects up these regular and irregular changes with the fisheries, and concludes that there exists a close connection between hydrographic, meteorological, and biological phenomena which should in future be taken into account.

ANTARCTIC EARTHQUAKES.

THE *Discovery* carried with her to the Antarctic regions one instrument which kept her, to a slight extent, in touch with the outer world. During the long intervals between the visits of the relief ship there was no word of sport or of the strife of party politics which fill so large a space in the daily papers, but from time to time the Milne seismograph told that somewhere there had been a great earthquake, and in some cases could even say approximately where it had taken place. Now, the records are serving another purpose, and the first instalment of their discussion has appeared as a "Preliminary Note on Observations made with a Horizontal Pendulum in the Antarctic Regions," read before the Royal Society by Prof. J. Milne, F.R.S.

In all, some 3000 feet of films, obtained by Mr. Louis Bernacchi, were brought back by the *Discovery*, and, as might be expected, their examination is still incomplete, in spite of the assistance which Prof. Milne acknowledges; yet one result stands out from the wealth of hints and suggestions which crowds the paper, in the discovery of a new submarine earthquake region lying to the south-west of New Zealand, from which came 73 out of the 136 distinct earthquakes recorded. This, however, does not end the matter, for it is found that not a few of these earthquakes were also recorded by the Milne pendulums in England, that is, near the antipodes of the origin, but not by similar instruments at a less distance. The explanation offered may best be illustrated by a simple experiment, which anyone can perform; take a circular tub containing water, dip your hand into the middle and raise it sharply, thus setting up a group of waves which travel outwards from the centre, becoming less and less conspicuous as the circles widen, until they may cease to be visible; presently, however, the reflected waves, con-

verging on the centre, will become visible, and, as the circles narrow, the waves get higher and more conspicuous until the centre is reached again. So the earthquake waves may become too small to be registered as they spread out from the origin, but again affect a seismograph as they converge towards its antipodes. Doubtless it is not only the earthquakes of the newly discovered region in which this takes place, but the present distribution of teleseismographs is not such as will allow of its being established in the case of other earthquake regions.

Apart from these results, which seem well established, there are many suggestions contained in the paper, two at least being important ones. The first of these concerns a peculiarity in the distribution of the stations at which earthquakes are recorded; for instance, those originating in the region to the south-west of New Zealand will be recorded along a band, of about 20° in width, starting in a north-westerly direction, but not at stations lying, nearer the origin, on one side or other of this band. So, too, earthquakes originating off the west coast of South America have been recorded in western Europe and, near their antipodes, in Siberia, but not at stations which we should expect them to affect were they propagated with equal intensity in an opposite direction.

The other suggestion, which may prove of great importance, concerns the diurnal east and west movement of the horizontal pendulum. This only affects pendula which point north and south and swing east and west; it is only noticeable on days when the sun shines, and has been attributed to the action of the sun's rays in heating or drying up the ground on either side of the recording station. These explanations have not proved satisfactory, and it is now suggested that the movement may be due to some other indirect effect of the sun, probably of an electrical nature. The Milne pendulum, with its silk fibre suspension and agate cup bearing, is practically insulated, and Prof. Milne finds that one of his pendula, after being electrically connected to earth, and therefore preserved at the same potential as the outer case and walls of the observatory, does not show the extensive movements it did prior to being earthed. This line of research is being carried forward with the cooperation of Dr. C. G. Knott, of Edinburgh, and we look forward to seeing some interesting results in due course.

We have indicated the most interesting of the results which have come from the seismographic records of the Antarctic Expedition; want of space forbids us to detail the many other suggestions and possibilities set forth by Prof. Milne, but what has been noticed is enough to show the good use that has been made of the record which, taken by itself, has little value, and only becomes important when correlated with those of the thirty-eight other stations where the Milne type of instrument is now installed.

TECHNICAL EDUCATION FOR FISHERMEN.

ABOUT six years ago the Lancashire Sea Fisheries Committee instituted practical classes for the instruction of local fishermen in the natural history of the common marine edible animals. "Technical education" in the strict sense of the word was not the object aimed at. For some time previously the committee had experienced considerable difficulty in enforcing the restrictions on methods of fishing contained in their by-laws on account of the determined opposition of the fishermen, and the object of the classes was rather to remove this opposition by showing the *rationale* of the by-laws, and to create a common ground on which both officers and fishermen could meet. The committee had no funds which they could apply to this work, and the classes were only made possible by the cooperation of the Technical Instruction Committee of the Lancashire County Council, which made an annual grant of 250*l.* to be spent for this purpose.

Practically all this money is expended in providing "fisheries exhibitions" of the value of 5*l.* each. One or more of these is allotted to each fishing centre in the administrative county of Lancaster, and the men selected to attend are chosen in various ways. In some cases they are selected by the fishermen's associations, and in other cases they are chosen by the officers of the committee. The grant of 5*l.* is intended to recompense the fisherman exhibitioner for the loss of his labour during the time he attends the class, and to provide for his expenses during this period.

The first two experimental classes were held at the (then) University College of Liverpool, but subsequently the work was transferred to the Lancashire Fishery Station at Piel, in the Barrow Channel, where tanks and other apparatus for the study of living organisms are provided by the fisheries committee, and where living material can easily be landed by the committee's vessels. The men are brought to Piel and taken away again by the patrol steamer, and lodge in the neighbourhood of the station. Each class consists of fifteen men, the maximum number which can be taught at one time with advantage. Twenty two-hour lessons are given during each course.

The course of instruction was drawn up by Prof. Herdman and Mr. Johnstone, and great care was taken to arrange a logical sequence of lessons. The structure of a typical fish is the first lesson, and this is followed by an account of the life-history of a typical mollusc such as the mussel. A short demonstration of the main chemical and physical processes involved in the respiration of marine animals is then given, and the manner of feeding of two such divergent types as the fish and mussel is then considered, a discussion which naturally leads up to three or more lessons on the nature and occurrence of plankton and on the economic importance of the latter. The remaining lessons deal with the life-histories of other economic marine animals, the cockle and oyster among Mollusca, and the shrimp and crab among the Crustacea. The life-histories of various fishes, such as the flat-fish and skate, are also considered, and the development of the flounder is studied from the process of fertilisation up to the time when the embryo issues from the egg. Although lantern and other demonstrations are given, the instruction is in the main practical in character, each man being provided with a good microscope and a set of dissecting tools.

On the whole the results of the classes have been very satisfactory; the main object, that of bringing about a better understanding between the fishermen and the committee, has been attained, and though there is still considerable opposition on the part of the fishermen towards the by-laws, yet the relations are much less embittered than was formerly the case. Another result of considerable importance has been attained in that the shell-fish transplantation operations carried on at Morecambe (an account of which was given recently in NATURE, August 31, p. 430) have been traced directly to the stimulus afforded by the classes. This work was originated by the Morecambe fishermen themselves, and it was in this district that the fishery classes were most appreciated and supported.

J. J.

LIFE-HISTORY OF THE EMPEROR PENGUIN.[1]

THE emperor is the largest of all the penguins, and is limited strictly to the ice-covered regions of the Antarctic. The interest of its life-history lies chiefly in the fact that its breeding ground was first discovered during the recent expedition made by the *Discovery* into the Antarctic. Its young and its eggs were brought home for the first time when the *Discovery* returned to England in September, 1904.

In reviewing the life of this bird, the difficulties of investigating its breeding habits were explained as the result of certain peculiarities; for example, that of laying the eggs in the middle of the winter darkness; each hen laying a single large egg, which it incubates as it stands in an upright position on sea-ice, keeping the egg from contact with the actual ice by holding it on the *dorsum* of the foot, and allowing a heavily feathered fold of skin to fall over it from the abdomen, thus completely obscuring it from view, and keeping it closely appressed to the abdomen, warm enough to hatch out, probably in some seven weeks. In the coldest month of the whole year,

[1] Abstract of a paper delivered before the Royal Institution by Edward A. Wilson.